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ABSTRACT

Changes in the American economy and in the nature and organization of work fundamentally challenge the educational system and have implications for the Federal Government's role. Case studies of the insurance, banking, and textile industries demonstrate the following changes in the nature and structure of work: (1) both service and manufacturing industries are moving from a production orientation to a product and customer orientation, from mass production to flexible production; and (2) computerization usually increases skill demands. The following disconnections between education and the economy are discussed: (1) mismatches between school and non-school settings in the structure of knowledge used and the social structure of its use; (2) differences between employers' and educators' perceptions of problems; (3) problems with the signalling systems between school and work settings; and (4) organizational differences between schools and industries. The following economic changes that affect post-secondary education and training are discussed: (1) conflict between labor demand and supply; (2) employers' training investment patterns and their consequences; and (3) changing patterns of employer training investment. The following recommendations for the federal role in education are discussed: (1) reconceptualize the federal role in education; (2) lead efforts to revitalize education; (3) invest in educational research and development; (4) eliminate narrow job-specific vocational education at the secondary level, integrate academic and vocational learning, and extend this integration through the elementary grades; (5) unify education and training policy; and (6) think through a policy on training vouchers for workers. A list of 51 references is appended. (FMW)

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EDUCATION AND THE ECONOMY: A DIAGNOSTIC REVIEW AND IMPLICATIONS FOR THE FEDERAL ROLE

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Occasional Paper No. 1

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PREFACE

This paper depends heavily on research funded by the Office of Research, of the Office of Educational Research and Improvement, U.S. Department of Education. This support was a five-year grant for the conduct of the National Center on Education and Employment; the National Center is based at the Institute on Education and the Economy, Teachers College, Columbia University, in New York City.

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I. A FRAME OF REFERENCE

This paper takes changes in the American economy and in the nature and organization of work as its points of departure, treating these realities as forcing events relative to our educational system. However, economic changes and the educational challenges that they pose are symptomatic of broader changes in the rules of engagement that govern relations between the United States and other nations. Shocks to our economy, attributable in part to aggressive international competition, represent simply the most recent assault on the American sense of safety and ability to control the world, an earlier instance being the Soviet Union's successful A- and H-bomb tests, which, together with intercontinental ballistic missiles, shattered our sense of invulnerability to foreign wars that we had not chosen to enter. On several fronts--not just economically,[1] but also politically, socially, environmentally, and normatively--the United States is being forced to function as part-of-the-world, rather than as separate-from (American isolationism) or in-control-of-the-world (American hegemony). It is this broader change that challenges our educational system most fundamentally. From this perspective, changes in our economy can be seen simply as a language or metaphor for talking about these changes.

At the same time and for obvious reasons, economic changes and their challenges to our educational system are real and urgent. Four perspectives frame the body of this paper.

First, labor is only one input to the production of goods and services. Therefore, *changes* in the quality of labor--and changes in education that affect the quality of labor--can have only limited effects on productivity and economic growth. Economists disagree on how limited "limited" is--some, such as Baily and Chakrabarti (1988), argue for small effects; others, such as Thurow (1986), for substantial ones. However, economists agree that *multiple* factors, such as the quality of technology, level and type of corporate R&D investments, and the quality of corporate management, as well as the quality of labor, drive the performances of American firms, industries, and the economy. They also usually agree that these factors are highly interdependent: the effects of improvements in one factor will depend on the nature and level of other factors. Thus, marked improvements in American productivity and economic growth rates require improvements in all factors of production, not just in one or two.

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[1] As Lester Thurow (1986) noted, "There is no such thing as the 'national' economy in the sense that we used to talk about it 20 or 30 years ago...it is becoming fully integrated with the rest of the world."

Second, this paper approaches education from the perspective of human capital development--in terms of the development of generic (but not narrow job-specific) work-related skills and orientations. Institutions other than schools shape this nation's human capital development, and schools have functions other than human capital development. However, this paper assumes that our schools represent major engines of human capital development and assesses the implications of economic changes for them.

In the past this perspective has been criticized--quite properly, I think--as too narrow a lens through which to see education. Implicit in this critique has been the image of educating the hand, not the head; of teaching specific and limiting rather than general principles; of socializing (breaking?) the individual to hierarchical and restrictive economic institutions that contravene democratic ideals of equality and freedom.

Ironically, these critics are right about how economic activity often *used to be* organized in this country and how elementary and secondary schooling is often *still* organized. However, perhaps for the first time in our history, the different objectives of education seem to imply similar curricula and pedagogy. In other words, we may not have to choose--the education needed to function effectively in labor markets in both high *and low* skill jobs looks similar to that needed to participate effectively as citizens, to work through the terrible moral dilemmas posed by a comatose aged parent, or to make intelligent purchases of often complex goods and services, such as housing, education, insurance, financial investments, and health care. The educative challenge common to these disparate activities is to prepare individuals for thoughtful *choice and judgment*. From this perspective, variations in curriculum and pedagogy should have less to do with variations in educational objectives than with variations in how different customers of the schools learn.

Third, the skill requirements of the economy need to be distinguished from our educational objectives. The skills that jobs require are not necessarily those that individuals require. This point is aimed at two frequently voiced arguments: either that the net effect of the American economic transformation is to *decrease* skill requirements, or that many--especially low skill--jobs are unaffected by the transformation. For both of these arguments, the often unstated implication for education is "business as usual"--in other words, a continuation of "tracked" education into what can be termed elite versus mass education.

These arguments are faulty in both their reading of the economy and their implicit conclusions for education. Our increasingly solid understanding of changes in the American economy partly supports one of these arguments--not all jobs are restructuring. For example, janitor, waitress, or bartender jobs today look like these jobs twenty or forty years ago. However, the interpretation of this fact is what is at issue. Historical occupational data for the civilian and military sectors show a clear, long-term employment shift toward higher skill jobs (U.S. Bureau of the Census, 1975; 1983; and 1987; Binkin, 1986; Berryman, 1988). Although recent industry case studies show little or no change in *some* lower skill jobs, a major story of these studies is the restructuring *especially* of lower skill work--and in ways that blur distinctions between lower and higher skill work. Further, where we find companies that are not changing how they produce--and therefore not restructuring jobs, we often find marginal companies that will be vulnerable to any future economic shakeout of their industries (e.g., Bailey, 1988).

Let us now turn to the implications for education. If our social objectives for schooling are to give every child his or her best shot at riding the crest of a changing economy, we owe these children the education increasingly required across jobs of many types, if not by all types of jobs. There has been a great deal of discussion about "dead end jobs". Without denying that discrimination--whether based on race, ethnicity, gender, age, or handicap--is still alive and well in labor markets, the power of discrimination to "box" or "trap" individuals in bad jobs, regardless of their capabilities, has waned over the last quarter century. Increasingly, jobs are becoming "dead end" because *people* are "dead end"--they lack the education to move into better jobs or to accommodate an "upskilling" of their old jobs. Recent industry studies, discussed below, show that companies are relying increasingly on lateral entry workers, selected for the education and training that they bring into the firm. This strategy "strands" the less educated component of the company's work force, from bank tellers to textile mill operators. Since external hires fill the higher level slots, the less educated workers do not receive either the training or the work experience associated with moving up through the firm. Promotion and therefore wage growth depend on obtaining more education and training.[2]

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[2] Noyelle (1987) uses the terms *professionalization* and *para-professionalization* of jobs to describe this pattern of mobility that seems to have become more occupation- than firm-driven. In other words, access to jobs beyond the established professions seems to depend increasingly on the kinds of investments typical of the professions: (1) individual investments in education and training to obtain control over a body of knowledge and practice; and (2) the sale of this expertise in a self-employment context, market-mediated work arrangement, or through lateral entry into the firm.

Finally, educational expenditures--most of it public sector--are enormous. In 1985 the elementary, secondary, and post-secondary bill alone was $222 billion, or 5.5 percent of a GNP of $4,010 billion. If we add the costs of government employment-related training programs, a conservative estimate of military training costs, costs of government-provided formal training for its civilian employees, and a very conservative estimate of the costs of corporate-provided formal training ($25 billion), the percent of GNP increases to 6.8 (Office of Technology Assessment, 1988, Table 3-26, p.129). With numbers like these, productivity improvements in this sector can yield big payoffs.

This paper is organized into four parts: changes in the economy that have implications for the elementary and secondary educational system; elementary and secondary education as a picture of disjunctures; economic changes that affect the post-secondary educational system; and implications for the federal role. Sections of the paper differ in their evidentiary base: some derive directly from the research, some spark across gaps, and some put together unlikely ideas to ask whether they might suggest something new to us. The paper describes the knowledge base for different sections.

II. THE TRANSFORMATION OF THE AMERICAN ECONOMY

HOW DO WE KNOW WHAT IS HAPPENING?

Two data sources tell us about the skill implications of changes in the American economy: (1) data on employment by occupations, past and projected, available for the nation (and, under some circumstances, for geographic subunits) from the U.S. Bureau of Labor Statistics (BLS) and the U.S. Bureau of the Census; and (2) industry and occupational case studies that reveal qualitative changes in the nature and structure of work that occupational titles conceal.

The BLS and Census data tell us about past and projected employment by occupational categories or names. *Occupational "names" contain no information about job content or skill requirements*; whatever we know about occupational content and skill requirements, we know from other sources. For example, the name of an occupation can remain the same, but its content can change--sometimes dramatically, as in the case of the claims adjuster job. (See below.) Similarly, knowing an occupation's job content does not tell us about skill requirements; content still has to be translated into what workers have to learn in order to perform the job.

"Economic restructuring" essentially means a fracturing of old relationships between occupational titles, job content, and skill requirements. It is under these conditions that occupational and industry case studies become critical complements to statistics on employment by occupation. These case studies describe what an occupational name means in terms of its job content and skill requirements, how content and required skills are changing, and how these might vary, depending on the nature of the industry or the type of company in which the occupation occurs. The problem with these studies is that, in practice, they can give us only partial knowledge about the occupational structure of the economy. Case studies are costly to conduct and to up-date. Thus, they will always fill in only some of the "cells" of the occupational structure. Accordingly, case studies present a constant generalizability challenge.

The rest of this section discusses: (1) what historical occupational employment data in civilian and military sectors tell us about skill requirements; (2) what illustrative industry case studies reveal about changes in the nature and structure of work; and (3) how results of these studies map against occupational projections.

SKILL TRENDS IN EMPLOYMENT BY OCCUPATION

Census and BLS statistics show a clear change between 1900 and 1980 in employment shares by broad occupation group. If we are willing to use our gross understanding of the skill levels of these very broad occupation groups, *these data show a clear long-term increase in skill requirements*. For the experienced civilian labor force, Table 1 shows the ratio of employment in each occupational group to the total experienced civilian labor force. These ratios are only approximate; occupational categories shift across time, although these shifts are less problematic at the level of the broad categories that we are using. In the first 80 years of this century, the biggest occupational shifts were from the farmer and laborer (farm and non-farm) categories to the white-collar occupations (professional/technical, managers/officials/proprietors, clerical, and sales). The craft, operative, and even the service occupations were quite stable in their shares of the total labor force between these two points in time.

In terms of the educative implications of these shifts, perhaps the most dramatic change occurred in the highest and lowest skill jobs. In 1900 about 30 percent of the labor force worked as laborers, either farm or non-farm; about 10 percent, in either professional, technical, or managerial occupations. By 1980 these percents had roughly reversed, about 6 percent working as laborers and 26 percent as professionals, technicians, or managers.

The military occupational structure shows similar upward shifts in skill requirements (Binkin, 1986; Berryman, 1988). In the forty years between 1945 and 1985, the share of the enlisted force in white collar occupations shifted from 28 to 47 percent, a shift primarily attributable to an increase in technical personnel from 13 to 29 percent. Blue collar employment declined from 72 to 53 percent, most of this decline being absorbed by the supply and service occupations (17 to 10 percent) and general military (including combat) occupations (24 to 16 percent).

When we turn to occupational projections for the period between 1986 and 2000, the forty occupations expected to evidence the largest job growth during this period include traditionally low skill jobs such as retail salespersons, waiters and waitresses, and janitors and cleaners (Table 626, *Statistical Abstracts: 1988*, 1987). However, Bailey's (1988) analysis of the BLS projections for the total occupational structure indicate that higher skill occupations will account for a slightly *larger* share of total employment by the year 2000 than in 1986. In other words, employment in these

Table 1. Ratio of Employment in each Occupational Group to the Total Experienced Civilian Labor Force*: 1900 and 1980

Occupational Group	Year			
	1900		1980	
	N (in thousands)	Ratio	N (in thousands)	Ratio
TOTAL EMPLOYMENT (In thousands)	29,030		106,067	
Professional/Technical	1,234	1:23	16,374	1:7
Managers/Officials/ Proprietors	1,697	1:17	11,414	1:9
Clerical/Kindred	877	1:33	19,502	1:5
Salesworkers	1,307	1:22	6,592	1:16
Craftsmen/Foremen	3,062	1:10	13,692	1:8
Operatives (Transport & Non-Transport)	3,720	1:8	15,909	1:7
Non-Farm Laborers	3,620	1:8	5,346	1:20
Service, Including Private Household Workers	2,626	1:11	14,367	1:7
Farmers/Farm Managers	5,763	1:5	1,498	1:71
Farm Laborers and Foremen	5,125	1:6	1,373	1:77

* The experienced labor force is defined as all those employed plus those unemployed who are not new entrants to the labor force. Thus, the difference between the number participating in the labor force and the experienced labor force is the number of new entrants. The occupation of the experienced labor force is defined as the occupation of the current job for those working and the occupation of the last job for those unemployed.

Sources: For 1900: Series D 182-232, U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*. Bicentennial ed., part 1, 1975, p.139. For 1980: Table 16, U.S. Bureau of Labor Statistics, *Handbook of Labor Statistics*. Bulletin 2175. Washington, D.C.: U.S. Government Printing Office, 1983; and Table A-26, U.S. Bureau of Labor Statistics, *Labor Force Statistics Derived from the Current Population Survey: A Databook, Vol. I*. Bulletin 2096. Washington, D.C.: U.S. Government Printing Office, 1982.

occupations will grow slightly more than employment in lower skill occupations,[3] their 1986 employment share being 39.8 percent and their projected 2000 employment share being 40.7 percent.

INDUSTRY CASE STUDIES: CHANGES IN THE NATURE AND STRUCTURE OF WORK

Research on changes in the nature and structure of work bears on what schools should teach. In the context of a National Center on Education and Employment research program, Columbia University economists, Drs. Thierry Noyelle and Thomas Bailey (Noyelle, 1987, 1988; Bailey and Noyelle, 1988; Bailey, 1988), document these changes in different types of industries: service and manufacturing, top-of-the-product cycle and bottom-of-the-product cycle, high technology and low technology.

The concept of **flexible production** is central for understanding all three cases. In fact, from the point of view of human capital development and schooling, **the key change in the economy for both the manufacturing and service sectors is a shift from mass production to flexible production.** Key to flexible production is the functional flexibility inherent in computer software. When production depends on "hard" automation, the retooling required to produce varied output is very costly. Under a "hard" technological regime, the objective is long production runs that drive down per unit cost. Ever since Henry Ford mobilized the labor of low skilled factory workers through the assembly line to replace teams of skilled workers, "hard" technology has almost always been synonymous with the specialization of labor.

As technologies become computer-based, they become "flexible" in that retooling simply requires reprogramming, thus allowing shorter production runs and more varied or customized production. Under a flexible production regime, the objective is to combine the customizing implicit in craft production at the cost savings of mass production. Flexibility has usually been achieved by reversing Ford's process: moving back up the range of skill levels, shifting from specialized to general purpose tools and machines, and reorganizing how people get the work done.

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[3] Bailey categorized as higher skill the executive, administrative, managerial, professional, technical, and precision production, craft, and repair occupations. The lower skill occupations included the sales, administrative support (including clerical), service, private household service, operator, fabricator, and laborer occupations.

Computerization in the insurance industry has caused five distinct jobs to be folded into one. These five jobs were:

- messenger
- file clerk
- customer assistance clerk
- claims adjuster, and
- policy writer.

When the insurance industry ran on paper, it required file clerks to categorize the paper and messengers to move it among offices. Computerization virtually eliminated these jobs and combined the other three jobs. The customer assistance clerk had been essentially an *order-taker*; he or she answered the telephone, recorded what the customer needed, and routed that request to either a claims adjuster or to the policy writing group. With the advent of computers, the person who now answers the telephone is expected to complete these routine and not-so-routine interactions during one call. He or she works with a computer terminal and software that give him or her access to claims settlement files and to information about the nature of and rates for insurance coverage that the company offers. The computerization of policy writing rules and the printing speed of laser printers allow--and therefore require--the person to customize insurance contracts.

Today the person who performs this combined job is often called a claims adjuster. However, the skills required to perform this job are greater than those associated with any one of the original five jobs. The job occupant is less an order taker than an advisory analyst. He or she has to have good communication skills and be able to help diagnose the customer's needs through an analytic series of questions and answers. The person needs less specific and splintered knowledge and more systematic and abstract knowledge--the ability to understand multiple arrays of information, the rules governing them, and the relationships between arrays. He or she also needs to be able to frame answers to less standardized requests. Insurance companies used to hire high school dropouts or graduates for the five jobs. They now hire individuals with at least two years of college for the restructured claims adjuster job.

This case provides us with a warning about using occupational projections to infer future skill requirements. The name of a job can remain the same--as has the job of claims adjuster--but change dramatically in content and skill requirements.

The **banking industry** has been subject to three forces:

- increased international competition;
- increased domestic competition as the result of deregulation; and
- computerization.

Before computerization and de-regulation, banking involved few services or "products", and its mode of operation was a mass production mode--the rapid and accurate processing of millions of a small number of different types of transactions. During this era top bank management consisted of college graduate generalists; the bank branches operated with a branch manager, assistant manager, head teller, tellers, and clerk/typists who did the routine paperwork for activities such as opening accounts. The tellers were usually high school graduates with traditional accounting skills, and promotions to low level management came from this group.

In the last decade bank de-regulation has generated an explosion of services--from three or four to as many as 35, as banks compete for market shares. This explosion drives banks toward a market and customer orientation --toward customizing. In other words, it has forced banks out of a mass production mode toward a flexible production strategy, with consequent changes in skill requirements and staffing patterns.

Today the teller job is highly routinized, simply a human alternative for customers who do not like to use automated banking services. The desk jobs, previously the clerk/typist jobs, are still the jobs that deal with customers' service needs. However, individuals in these jobs now must be able to analyze a much wider array of the customer's financial needs, understand the array of the bank's financial services, and, if possible, produce a match--in other words, make a sale. Banks find that they can hire part-time and less educated help for the highly routinized teller jobs, but must hire college graduates for what used to be the clerk-typist jobs. Banks find that they need people who can analyze and deal systematically with an array of data. Promotions now come out of the desk jobs, not the teller jobs--in fact, tellers are essentially isolated from promotion opportunities in the bank. At the same time, the skill requirements at the *top* of the bank have also changed. Banks now need, not college graduate generalists, but highly trained specialists--financial analysts and computer systems analysts, for example.

The **textile industry** competes on the basis of cost, quality, service, and product choice. During most of the post-war era, the U.S. textile industry focused on cost-cutting through the rationalization of the production of long runs of fabric. In the face of aggressive foreign

competition, U.S. firms entered a new wave of technological modernization and automation, the industry moving from forth-eighth out of sixty-one manufacturing industries in 1960 in average age of equipment to second by 1980.

However, developments in textile markets--indeed, in markets for almost all goods and services (recall banking)--have put limits on the industry's ability to use a mass production strategy. The greater segmentation of markets and the faster changing of styles have shrunk the market for large production runs of identical fabric. Even such a staple mass-produced commodity as denim now comes in dozens of weaves, colors, and finishes. Faster changing seasons have also had their effect. In apparel, styles become obsolete much more rapidly. Thus, apparel makers are less likely to order large quantities of the same material. The changes in styles are reflected in increases in stock-outs and markdowns. Forced markdowns, which are necessary when retailers fail to sell items during the appropriate season, have increased by 50 percent during the last decade. Industry estimates suggest that losses from stock-outs, which occur when retailers run out of hot items, amount to 8 percent of sales.

Among U.S. textile producers it has now become an article of faith that the textile industry must become more "market driven"--that is, the industry must be capable of producing shorter runs of many more styles. Managers of every mill studied reported increases in the number of styles produced--for example, from three to thirty-five in two years; from one hundred to three hundred in five years.

In other words, although there will always be a market for basic textiles produced in long runs, the industry as a whole must also be able to produce a wider variety of goods, on shorter notice, and at a reasonable cost--in other words, must increase flexible production. The development of flexibility in production is fundamentally a process of reducing the cost differential between standardized goods produced in long runs and a more varied output produced in smaller batches. Custom-made products could always be acquired at a price. Ever since Henry Ford mobilized the labor of low skilled factory workers through the assembly line to replace teams of skilled workers, technological innovations, at least in the United States, have almost always been synonymous with specialization of labor and mass production. Flexibility has usually been achieved by reversing Ford's process, moving back up the range of skill levels, shifting from specialized to general purpose tools and machines, and reorganizing how people get the work done.

What has happened to skill requirements in the textile industry? In this industry most jobs are machine operator jobs (lower skilled) or machine maintenance jobs (higher skilled). The ratio between the two is changing, from 4.2 operators to one technician in 1975 to 3.5 operators to one technician in 1985. For the operator jobs, technological innovation means that each particular task is easier. However, this narrow conception of skills is misleading; many operator jobs today are more demanding. First, modern looms, winders, open-ended spinning frames, and programmable knitters are much more expensive than the equipment they replaced. Operators must now try to prevent machine stoppages--"down-time" is now much more costly. This requires a broader understanding of the production process within which the operator works. It is no longer enough for individuals just to understand the particular task to which they are assigned.

Second, because of the increase in the number of styles produced by each mill, many operators are likely to be engaged in a greater variety of activities and in more of the activities necessary for changing styles. Their jobs are less well-defined than they used to be, and the tempo of production places a greater burden on operators to function within this uncertainty. As one personnel manager for a plant noted, "Our operations change too fast to be able to spell everything out. Operators have to be better able to figure things out for themselves."

Third, textile firms are also becoming more actively involved with working jointly with clients in developing new styles and fabrics. So far, at least in the firms visited for this project, this strategy does not seem to have had much of an impact on the shop floor, but forward-looking firms are starting to consider how the operators could contribute. The same could be said for on-going technological innovations. Many of the most important changes have been small adaptations of existing machines, and operators could make important contributions to these efforts.

The higher level positions in the mills also need greater skills and educational preparation than they did in the past. In the textile industry, the skilled occupations involve machine repair. In the past, textile machines were intricate, but the mechanical principles underlying their construction were not complicated. How these machines operated could be *visually* observed, and experience that many workers had in their own homes working on automobiles or farm machinery was relevant to fixing them. Loom fixers and mechanics in spinning and knitting mills were almost always promoted from the ranks of machine operators. Working around the machines had already given them a feel for what was necessary, and the additional training needed to become a fixer was acquired on the job with little or no formal instruction.

This situation has now changed. Most machines now have microprocessors and other electronic components, as well as sophisticated sensors and yarn splicers and knotters. This equipment is well beyond the experience that most workers get in homes and on farms. Since important machine components are not visually observable, operating the machines does not provide much of a sense of what it takes to repair and maintain them. In other words, to understand, diagnose, and fix the new machines, technicians have to be able to represent their structures and processes *symbolically* in their heads. To do this they have to be able to follow complicated manuals, diagrams, and updates provided by the manufacturers. Literacy requirements have accordingly shot up. The mills can no longer fill many technician slots from their traditionally semi-literate operator labor pool. They are adjusting to the problem in different ways. Some, reluctant to disrupt their internal promotion patterns, are paying for employees' literacy training. Others are violating these promotion patterns by hiring better educated labor in lateral moves into the technician jobs. This response strands operators, just as tellers who do not obtain more education are cut off from the promotion opportunities of the bank. However, whatever the mill response, states in which the mills are concentrated, such as the Carolinas, suddenly have mill owners' support for higher quality elementary and secondary education.

In sum: In both the service and manufacturing industries we are moving from a *production*-oriented to a *product*-oriented and *customer*-oriented world, from mass production to flexible production. In all of the industries studied, Bailey, Noyelle, and other researchers have found that increased competition, volatility, and uncertainty in the market have created strong pressures on all levels of the production process to be more responsive to changes in tastes and demand--to "customized consumption" (Noyelle, 1987). Indeed, it has become increasingly difficult to separate the marketing and product development functions from the production process itself, and this has profoundly disrupted the traditional production technologies.

Industry case studies clearly settle the debate over "upskilling" and "downskilling"--in other words, a debate over whether computerization increases or decreases the skill demands of jobs. Computerization usually--not always--increases skill requirements for two reasons.[4] First, the most efficient use of the technology encourages the reintegration of tasks once distributed among several

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[4] When computerized equipment is first introduced into a firm, it can sometimes be used initially in a way that reduces the total skill requirements of the job. However, when this occurs, the effect seems short-lived.

echelons of workers. And second, as intelligent machines take over processing functions, workers are left with diagnostic and problem-solving functions (Noyelle, 1987).

Although the ability to work on new machines is important, many of the most important changes cannot be understood as quantitative. Asking whether the work requires "more" or "less" skill inevitably focuses the analysis on limited and often secondary aspects of the transformation underway. Productivity gains are coming as much from changing the way that workers work together, their orientation towards their work, and the nature of their responsibility for and involvement in the firm's changing strategy and orientation towards the market as from applications of new technology. While many jobs used to be based on the repetition of a particular set of well-defined tasks, jobs now are more likely to demand varied and unpredictable responses to a variety of stimuli and information. Employment now involves interaction in constantly changing ways with production technology. The spread of micro-electronics and related technologies does not just result in new machines that must be mastered, but in a much deeper change in the way production is organized and the ways that workers relate to the production process and to each other.

RECONCILING OCCUPATIONAL COUNTS AND INDUSTRY CASE STUDY RESULTS

Reconciling these two data sources is theoretically possible, but in practice very difficult. Bailey (1988) has begun to try to create an approximate cross-walk between occupational counts and industry case studies.

Using the 1980 decennial census categories, he first split the occupational structure into high and low skill occupations. "High skill" jobs were classified as executive/administrative/managerial, professional, technical and related support, precision production, and craft and repair workers; "low skill", as salesworkers, administrative support (including clerical), service workers, private household workers, operatives, fabricators, and laborers. He then disaggregated the low skill occupations into two categories: "middle skill" and "low skill". He defined middle skill jobs as ones that at least potentially could be involved in the transformations documented in industry case studies. He defined low skill jobs as ones unlikely to be reorganized or transformed significantly. Thus, fast food counter workers were left in the low skill group; operators in manufacturing plants or clerical workers who manage information were classified in the "middle skill" group.

In terms of 1986 employment numbers, this exercise fairly evenly split those employed in the original low skill group into middle and low skill jobs. Thus, for 1986, 39.8 percent were employed in high skill jobs; 29.5 percent, in middle skill jobs; and 30.7 percent, in low skill jobs.

III. ELEMENTARY AND SECONDARY EDUCATION: A PICTURE OF DISCONNECTIONS

From the perspective of education and the economy, the American elementary/secondary system presents a picture of **disconnections**. Four important ones are: (1) mismatches between school and non-school settings in the structure of knowledge used and the social structure of its use; (2) differences between employers' and educators' perceptions of our human capital problems; (3) problems with the signalling system between school and work settings; and (4) organizational differences between schools and energetic industries and successful companies in businesses similar to that of schools (knowledge and communication). This section of the paper concentrates on the first of these four, the other three being only briefly discussed.

WHAT DO WE NEED TO TEACH? TO WHOM? WHEN? HOW?

As the educational implications of the restructuring American economy become clearer, the incomplete--sometimes perverse--nature of current educational reforms emerges. Those reforms targeted at improving students' academic skills are clearly appropriate--up to a point, academic and work-related curricula should be the same. However, documented changes in the nature and structure of work and advances in cognitive science argue for a second wave of reform that involves *fundamental changes* in *what* we teach, *to whom* we teach it, *when* we teach it, and *how* we teach it. In other contexts I have talked about this second wave of reform as "shadows in the wings", for the simple reason that--to shift metaphors--this airplane is not yet ready to fly. The issues raised here pose formidable research, development, and evaluation challenges in areas such as curriculum (and associated textbook or software materials), pedagogy, the preparation of teachers, concepts and measures of accountability, and school structure.

What Do Students Need to Learn?

What do industry studies imply about the core skills that students need to learn? Economic changes certainly imply the need for *good academic skills*. Perhaps the most profound educational implication of computers in the workplace is that they force a replacement of **observational learning** with **learning acquired primarily through symbols,** whether verbal or mathematical (e.g., Scribner and Cole, 1973; Bailey, 1988).

The textile case yielded one example, technicians now having to represent the structures and processes of their machines *symbolically* in their heads. Another example lies in machining, an occupation that employs about 2 million or two percent of the nation's workforce. In traditional machining, responsibility for part dimensions and tolerances, metal properties, and tool use is literally in the hands of the machinists whose knowledge of part geometry, metallurgy, output requirements, and tool functioning is extensive. Computerized numerical control (CNC) machines radically alter these processes of set-up, control, and operation, a decisive transformation being that they replace manual set-up and control with set-up by symbolic command. The symbol command system is a computer program which guides the movement of the machine parts and its operational tools through electronic impulse. This program does not mimic the manual movements of the machinist, but describes movements in a Cartesian space in which the point of origin is the machine itself. Whereas the machinist working on a traditional machine reads an engineer's blueprint and then manually adjust dials and levers to set up a particular operation, a machinist on the CNC machine reads the blueprint and then creates commands in a programming language to govern the machine's operations (Scribner, 1988b).

A third example lies in a family of technological systems known as manufacturing resource planning (MRP), which is carrying much of the burden of positioning American industries to compete. Thus, their effective integration into the workplace becomes critical. The MRP is a computer-based integrated information system that coordinates data about all aspects of a company's operations. It uses computer programs organized around functional modules such as inventory management, product control, and costing. MRP systems support such manufacturing innovations as "just-in-time" inventory and small batch customized production. Although initially restricted to large corporations, MRP is now spreading through middle and small-size firms in all branches of production.

From the perspective of academic skills, what is important about the MRP is that it is a *content-free, formal, closed conceptual system* that workers at *all* skill levels within the firm have to use. As such, it has many of the characteristics of "school" subjects, such as mathematics or grammar, and departs in significant ways from the traditional systems of knowledge that reflect accumulated managerial and production wisdom (Scribner, 1988a).

Changes in the economy, especially flexible production and changes in the time frame for production, combine to increase the need for *higher order cognitive thinking*, even for jobs that we

usually conceive of as lower skill. *Time* has become an important competitive weapon (Stalk, 1988; Bailey, 1989), companies that can respond to product or service demand quickly having a competitive edge. If the variation in product and service associated with flexible production multiplies the number of decisions that must be made, the time element makes it difficult to buck these decisions up and back down supervisory lines. Decisions are necessarily having to be made more frequently on the shop floor. Thus, work increasingly requires employees both in higher and lower skill jobs to deal with uncertainty, the unfamiliar, and discontinuity; to understand the firm's market environment and the organizational context in which the job is embedded in order to make decisions that are increasingly being delegated to the shop floor; to understand their technologies well enough to generate initial hypotheses about the source of breakdown for maintenance technicians so as to minimize delays in the production process. In sum, there is a stunning parallel between the cognitive requirements of today's workplace and the defining characteristics of higher order thinking,[5] and this parallel affects workers in lower as well as higher skill jobs.

The forces just described are also flattening out company hierarchies, eliminating supervisory and middle management positions. Supervisory functions are being increasingly delegated to the worker and/or to the team, requiring of previously supervised workers, not only the ability to make the decisions previously delegated to supervisors, but also the *ability to self-regulate or self-direct.*

Changes in the economy imply the need to *know how to learn*--in other words, how to organize social and technological resources to transform what is unfamiliar into the mastered, a process that requires knowing how to identify the limits of one's own knowledge, how to ask germane questions, how to penetrate poor documentation, and how to identify sources of information. The volatility of markets produces a volatility in job tasks--witness the profound transformation of the claims adjuster job, the teller job, the job of operator in textile mills, a story that is repeated in other industries, such as electronics manufacturing, apparel manufacturing, retail sales, and business services. As Noyelle (1987) observes, "We are moving into an era in which the

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[5] Resnick (1987a) defines higher order cognitive thinking as: being **nonalgorithmic**--the path of action is not fully specified in advance; being **complex**--the total path is not mentally "visible" from any single vantage point; often yielding **multiple solutions**, each with costs and benefits, rather than unique solutions; involving **nuanced judgment** and interpretation; requiring the application of **multiple, sometimes conflicting, criteria**; involving **uncertainty**--not everything bearing on the task is known; involving **self-regulation** of the thinking process, not regulation by others; involving **imposing meaning**, finding structure in apparent disorder; and being **effortful** (p.3).

traditional separation between working and learning is disappearing, with learning becoming increasingly integrated into a person's work life." (p.121)

Finally, changes in the economy require **teamwork abilities** and the **ability to resolve conflicts**. Under mass production, employees, especially those in factory floor and "back office" jobs, often worked alone, albeit in physical proximity to each other. As job responsibilities broaden and increasingly intermesh, workers have to function collaboratively--and classic research in social psychology shows that individual competence does not generalize to team competence. For example, pilot error accounts for an increasing percent of fatal airline crashes worldwide, and many analyses have pinpointed poor team performance as an important component of that error.[6]

As the labor force becomes increasingly multicultural and job content changes rapidly and in confusing ways, communication problems also increase between workers, generating the need for interpersonal communication and conflict resolution skills. These problems self-evidently reduce productivity; more subtly, they interfere with an important social mechanism for learning on the job--peer help (Scribner, personal communication).

Who Should Learn?

The skills just described are **generic** in that, in general, they cut across industries and occupations. Thus, everyone needs to learn them, not just some people. This does *not* mean that everyone needs to learn them in the same way. It does mean that, for these skills, our educational *objectives* for everyone need to be roughly the same.

This idea has been most problematic for higher order cognitive thinking. Like other industrialized nations, the United States has harbored two quite distinct educational traditions--one concerned with elite education, the other with mass education. As Resnick (1987a) points out, these traditions conceived of schooling differently, had different clienteles, and held different goals

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[6] As a recent *New York Times* article on cockpit error observed, "Two- and three-man airline flight crews...often don't work well together." In one example, the article noted a sharply critical FAA report on a major airline that had recently experienced several serious near accidents: "There is no evidence that Delta crews are (on the whole) either unprofessional or purposefully negligent....Rather...crew members are frequently acting as individuals rather than as members of a smoothly functioning team." (William Stockton, "Trouble in the Cockpit," *New York Times Magazine*, March 27, 1988, pp.38-40, 60, 63, 66-67.)

for their students. Thus, although "...it is not new to include thinking, problem solving, and reasoning in **someone's** curriculum, it is new to include it in **everyone's** curriculum." (p.7) This becomes one of the challenges facing compulsory American schooling--to make thinking and problem solving a regular part of a school program for all of the population, even rural populations, even minorities, even non-English speakers, even the poor--to assume that all individuals, not just an elite, can become competent thinkers.

When Should They Learn?

Early. We usually think about preparing students for the labor market during high school. However, we are talking generic work-related skills here, not occupationally-specific ones; for these, high school is too late. It is implausible to think that high school sophomores educated in a passive learning regime for the first nine years of their schooling can learn to self-regulate their learning in the tenth year. We can make analogous arguments about learning how to learn, about learning how to function effectively in teams, or about learning how to resolve conflicts.

For example, as Resnick (1987a) notes, the most important single message of modern research on the nature of thinking is that the kinds of activities traditionally associated with thinking are not limited to advanced levels of development.

> "[T]hese activities are an intimate part of even elementary learning....In fact, the term "higher order" skills is probably itself fundamentally misleading, for it suggests that another set of skills, presumably called "lower order," needs to come first. This assumption ....[i]mplicitly ....justifies long years of drill on the "basics" before thinking and problem solving are demanded....[R]esearch suggests that failure to cultivate aspects of [higher order cognitive] thinking may be the source of major learning difficulties even in elementary school. (p.8)

How Should These Skills be Taught?

From the perspective of schooling, the "whats" that should be taught do not necessarily translate into **courses.** They may have more implications for **how** material is presented than with what is presented. I am not an educator, but my hunch is that transforming the "how" will yield as much payoff as transforming the content of courses. The "how" strikes me as the toughest

challenge ahead for the educational research, policy, and practitioner communities. We know how to implement some of these ideas, although they are not commonly implemented--for example, how to use team and collaborative contexts for teaching and learning (e.g., Slavin, et al., 1985). However, other ideas, such as finding ways to teach content-free symbol systems within meaningful contexts, are still on the drawing boards.

This section relies heavily on pioneering work in cognitive psychology, cognitive science, and cognitive anthropology on non-school learning and its implications for how we structure formal learning.[7] At the heart of this research is the presumption that intelligence and expertise are built out of interaction with the environment, not in isolation from it. This work implicitly challenges our traditional distinctions between "head" and "hand", between "academic" and "vocational" education, between "education" and "training", and between school-based and work-based learning.

Coming out of this stream of research is a much clearer sense of how school-based learning and non-school learning differ from each other. In a *bravura* synthesis of the work in this field, Lauren Resnick (1987b) delineates four broad contrasts between in-school and out-of-school mental activity that raise profound questions about the utility and effectiveness of schooling for all non-school activity, including work of all types and for all learners, whether at-risk or not-at-risk. They stimulate us to rethink--radically rethink--how we teach in school.

The first contrast is between **individual cognition in school versus shared cognition outside**. Although group activities occur in school, students are ultimately judged on what they can do by themselves. Much of the core activity of the school--homework or in-class exercises--is designed as individual work. For the most part, students fail or succeed at a task independently of what other students do (aside from grading on a curve). By contrast, a great deal of activity outside of school is socially shared: work, personal life, and recreation take place in social systems in which what one person is able to do depends fundamentally on what others do and in which "successful" functioning depends upon the mesh of several individuals' mental and physical performances. This contrast argues for much more team and co-operative learning, the student being held accountable for both individual and team performance.

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[7] This section relies especially on the work of Sylvia Scribner (e.g., 1974, 1981, 1984, 1986), who helped launch this research direction in the early 1970s and now pursues it in the context of a research program for the National Center on Education and Employment.

The second contrast is between **pure mentation in school versus tool manipulation**. In school, the greatest premium is placed on "pure thought" activities--what individuals can do without dependence on "external crutches"--whether books and notes, calculators, or other complex instruments. While some of these tools may be used, even encouraged, during "learning", they are almost always absent during tests of performance. Thus, school becomes an institution that values thought that is independent of the physical and cognitive tools that are a vital and defining part of virtually all practical activity. Out of school, by contrast, most mental activities are intimately involved with and shaped by the physical and intellectual tools available, and the criteria for competence include the expert use of tools.

This contrast suggests that student performance be judged relative to the student's abilities to make effective use of tools, not independent of them.

The third contrast is between **symbol manipulation in school versus reasoning about things and situations that make sense to people outside of school**. School learning is mostly symbol-based, to such an extent that connections to the things being symbolized are often lost. Outside of school, actions are intimately connected with things and events, and because one is engaged with things and situations that make sense to people, people do not fall into the trap of forgetting what their calculations or their reasoning is about. Their mental activities make sense in terms of their immediate effects, and their actions are grounded in the logic of immediate situations. In school, however, there is a very large tendency for symbolic activities to become detached from any meaningful context. School learning then becomes a matter of learning rules and saying or writing things according to the rules. This focus on symbols detached from their referents can create difficulties even for school learning itself. For example, it can lead to systematic and persistent arithmetic errors of a kind that seem virtually absent in practical arithmetic.

This tendency for school knowledge to be disconnected from real life is not limited to mathematics--although it is particularly easy to draw clear examples from mathematics learning. The process of schooling seems to encourage the idea that the "game of school" is to learn symbolic rules of various kinds, that there is not supposed to be much continuity between what one knows outside school and what one learns in school. There is growing evidence, then, that not only may schooling not contribute in a direct and obvious way to performance outside school, but also that knowledge acquired outside school is not always used to support in-school learning. Schooling is coming to look increasingly isolated from the rest of what we do.

This contrast between in-school and out-of-school mental activity suggests that school-based learning is not strongly related to out-of-school activity for any individual. However, the disjuncture between school and non-school settings would seem to be particularly detrimental for at-risk learners.[8] We frequently assume that at-risk and not-at-risk populations differ in how they learn most effectively. Although it is an empirical question, variations in learning performances may attest partly to individual differences in the willingness to tolerate or in the ability to make sense out of a school-based or school-like experience that is relatively isolated from non-school experience.

Howard Gardner, author of ***Frames of Mind***, noted in an interview with the ***New York Times*** that "We subject everyone to an education where, if you succeed, you will be best suited to be a college professor."[9] If a student cannot envision participating in adult futures that are highly academic in content, two things happen. First, the individual cannot look to the school for his or her sense of ultimate place and trajectory--he or she must look elsewhere, and the school, in a basic sense, has lost that individual. And second, instruction in academic skills will become "irrelevant" to the person--or, in decision theory terms, without "utility". Decision theory presumes and countless studies show that individuals--children and adults, at-risk and not-at-risk, do things that have utility for them--that connect to what they want and where they expect to be going. From this perspective, traditional schools and schooling may be creating their own problems in reaching their own learning goals and helping to produce the "at-risk" learner.

This contrast, then, suggests instruction in the context of what makes sense to people. Especially for the academically less inclined, schools try to introduce "things and situations that make sense to people" either by putting the student in vocational education or by linking schooling to outside jobs, as in organized part-time work and part-time school ventures. There can be good reasons for doing either of these things, but not as a way of compensating for the often impoverished learning contexts of academic courses.

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[8] I define at-risk learners as those who do not perform well in traditional schools or training programs arranged like traditional schools, either because they are not very good at standard academic subjects or--and this is an exceedingly important "or"--because they do not want to be or do not see the point of being good at them. It is important to note that although at-risk learners come disproportionately from poor families, almost every family either has a child of this sort or friends with a child of this sort.

[9] November 9, 1986, Education Section, *New York Times*, p.23.

If earlier I argued that all students, not just the academically inclined, need to master higher order cognitive skills, now I am arguing that all students, not just the academically disinclined, need contextualized learning. I am talking about "vitalizing," not "vocationalizing," schooling. I think that working out what this means, how to do it, understanding how individual schools and teachers are already approximating it, represents one of the most exciting challenges ahead of us.

We are not starting from ground zero. The best teachers in our best schools already instinctively "vitalize" even the most "academic" of subjects, such as the fifth grade teacher in a McLean, Virginia school who runs a simulation of a small economy in the classroom to give her students experience with fundamental economic concepts such as competition, monopolies, bankruptcy, rents, or taxation. Reading a discussion of markets, sellers, and competition in a textbook means much more to the student who, just the previous day, waged a price war with a seatmate to corner the market on hot dog sales. "Taxation" means much more when another seatmate who represented government has bought the classroom door, forcing everyone to pay taxes every time they need to go in or out of the room--for example, to get water to boil their hot dogs.

Our vocational-technical, theme, or magnet schools hold important clues--many of these explicitly organize around meaningful activities that real people do in the real world, such as business careers, the performing arts, or science.

Another clue lies in the new information technologies. As the Office of Technology Assessment (1988) notes:

> [With the new information technologies, it] may soon be possible to manipulate images and sounds as easily as the printed word. This means being able to break some of the barriers of abstraction that separate "scholarship" from the world people see, hear, and understand....
>
> These innovations can radically change the performance and structure of the educational system. The new generation of technologies...are qualitatively different from the film strips, television shows, and other techniques that have been used in limited ways to augment instruction in the past. They represent something fundamentally new....

> There is also much to be learned about the role that games play in learning. In traditional societies, where children could see much of the work done by adults, play mimicked life. Skills learned in play...translated gracefully into the practical world....In principle, simulations can mix work with instruction and instruction with play in entirely new ways....After centuries without practical alternatives, people have become accustomed to think about communication in terms of words and books. New visual technologies, however, can provide a means of communication that is in many areas more powerful than language.... [I]t is obvious that words in a geography text are a poor substitute for a visit to Brazil....This power to imitate reality can have a helpful role in education....
>
> Pictures are a "second class" resource in any library. Technology now emerging can change this status by making it nearly as easy to retrieve, make, and modify images as words. (pp.242-245)

Many of us, myself included, glaze when we hear about "new information technologies." We have lived through generations of "silver bullet" computer-based instructional programs that whizzed by, only to bury themselves in the wall. We have seen the numbing, pedestrian ways in which the schools manage to use computers. However, I think that the OTA is right this time about the potential. The problem is getting from here to there. A sustained investment will be required to develop these technologies for pedagogic purposes. A major restructuring of the schools will be required to integrate these technologies into schooling. The information technologies do not parachute successfully into any organization, whether firm or school. Their effective integration into the organization always requires organizational restructuring.

The fourth contrast is between **generalized learning in school versus situation-specific competencies outside**. In school we aim for general, widely usable skills and theoretical principles. Indeed, the major claim for school-type instruction is, usually, its generality and power of transfer. Yet outside, to be truly skillful, people must develop situation-specific forms of competence. The "packages" of knowledge and skill that schools provide seem unlikely to map directly onto the clusters of knowledge that students will actually use in their work. This seems true even for highly technical knowledge, where schooling is intended to provide direct professional training. Studies of expert radiologists, electronic trouble-shooters, and lawyers all reveal a surprising lack of transfer of

theoretical principles, processes, or skills learned in school to professional practice. For example, Morris and Rouse (1985) found that extensive training in electronics and troubleshooting theories provided very little knowledge and fewer skills directly applicable to *performing* electronic troubleshooting. All of this points toward the possibility that very little can be transported directly from school to out-of-school use. Both the structure of the knowledge used and the social structure of its use may be more fundamentally mismatched than we had previously thought.

This contrast seems to me to pose a challenge to the research community before it does to the schools. Resnick notes that situation-specific learning is limiting. Studies have shown that when the situation is changed from the familiar--for example, by asking bookies in Brazil to accept unusual bets that cannot be constructed from their tables (Schliemann and Acioly, in press)--unschooled individuals have a great deal of difficulty and may fail entirely. Schooled people do better, although--and this is an important point--they rarely use the supposedly general algorithms that they have been taught in school and instead invent new solutions specifically appropriate to the situation at hand. However, what do they invent? How and why? Expert radiologists interpret X-rays using mental processes different from those taught in medical courses, textbooks, and even hospital teaching rounds (Lesgold, et al., in press). What processes do experts use? How did they learn them? Can they be taught? How? Do they bridge the worlds of the specific and the general? These studies raise questions that seem at the heart of the dilemma for schools.[10]

A contrast that Resnick does not identify is mastery of and retrieval from a defined body of structured knowledge in school versus the mastery of uncodified, emergent and evolving systems outside of school. Increasingly, non-school settings demand that we cope with the unprecedented and with information that is neither limited nor orderly. This reality puts a premium on the ability to create structure--on knowing how to learn--and on skills at locating and organizing

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[10] Scribner's work centers on this problem. In studies of workers in jobs that vary substantially in their symbolic and physical requirements, she found a set of attributes common to expert performance in all of the jobs: (1) flexibility in modes of solution to formally identical problems; (2) creative shortcuts that simplify and economize on mental and physical effort ("least effort" basis for organizing work); and (3) fine-tuning to the environment and effective utilization of setting-specific knowledge. She is now trying to understand how experts create expertise--for example, how less skilled workers learn manufacturing resource planning (MRP) systems, a computer integrated information system analogous to the closed, logical systems of school, such as grammar or mathematics. Less skilled workers often did not handle closed systems well when they were in school. How do they learn the MRP? What facilitates the learning? Do the processes of moving from novice to expert in the plant have implications for teaching closed systems in school?

social and technological resources to expedite learning. This contrast suggests that school should include learning situations where students are evaluated, not for having the "right" answer, but for figuring out how to obtain and structure the knowledge needed to create an orderly basis for action.

Vocabulary and Accountability

This previous discussion underlines the need for a new vocabulary. I used the term "academic" skills in the discussion of generic skills, but this term connotes decontextualized symbols and symbolic rules. "Basic" skills is worse, connoting workbooks and routine drill. "Contextualizing" connotes "vocationalizing," which is often used to imply the headless hand. "Higher order" cognitive thinking implies "lower order" cognitive thinking. We need a new language for thinking and talking about changes in who gets taught what, when, and how.

This section also implies rethought measures of school accountability. For example, the methods now being used to hold schools accountable--student scores on multiple choice tests of basic skills--militate against structuring the learning of subject matter to encourage the development of higher order cognitive thinking. As we know, we usually get the performance we test for. Multiple choice tests, although cheap to score, implicitly presume that "competence" is the ability to retrieve the "right" facts from a cognitive warehouse of facts, encouraging routine drill in bits and pieces. By definition, there are no right or wrong answers in the higher order cognitive world--only better and worse thinking.

EMPLOYERS AND EDUCATORS: ARE THEY LOOKING THROUGH THE SAME GLASSES?

Do economic and educational actors have similar views of our human capital problems? Is there a common ground for talking about solutions? A shared perspective is not a sufficient, but would seem a necessary, condition for reforming the schools.

In 1984 the Gallup Poll asked public school teachers and the general public to rate the importance of eight alternative goals of education on a scale of one to ten. Of these goals, the greatest differences emerged for the economic objectives of education, the teachers not endorsing an economic role for education.. Whereas 56 percent of the public gave the highest rating to the goal, "To develop an understanding about different kinds of jobs and careers, including their requirements

and rewards," only 20 percent of the teachers rated this as very important. Similarly, 46 percent of the public, but only 6 percent of the teachers, gave the highest rating to the goal, "To help students get good/high-paying jobs." (*Phi Delta Kappan*, 1985)

Other, albeit fragmentary, data indicate a disturbing difference between employers' and educators' views of schooling success.[11] We find that educators and employers may use the same words in describing what skills employers need and students need to be taught.[12] However, although there is usually some variance in each group--primarily among teachers, **in general employers and educators differ in their assessment of whether or not the schools are successfully meeting these needs.** Employers, citing statistics on the skills of those they see in the hiring process, consistently identify a major gap between the skills that they get and those that they need.[13] Educators, on the other hand, often do not see much, if any, gap; they feel that the schools are doing quite well--and are doing better--at meeting employers' needs.

Employers chronically and routinely complain about the quality of labor available to them (Hollister, 1984). However, these complaints seem more valid today. First, we see employers *acting* on their stated concerns, as evidenced by their increasingly aggressive efforts to improve the schools.[14] Second, the industry case studies and cognitive studies of learning in non-school settings

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[11] I would not go to court on the basis of these data, but they do square with my observations in two-and-a-half years of meetings, conferences, seminars, and work sessions with educators and employers. They also square with Kearns' mail response to his speeches about the schools. See the simultaneously hilarious and sad chapter, "The Postman Rings and Rings," in Kearns and Doyle (1988).

[12] I deliberately use the term "same words" because it is by no means clear that the words mean the same thing to different employers and educators or that employers or educators know what they mean by the words. Surveys of employers about their skill needs are fraught with these problems (Natriello, 1988).

[13] For example, New York Telephone Company reports that only 20 percent of applicants who take the test for the position of telephone operator pass. Michigan Bell Telephone Company reports that only two out of 15 applicants for clerical positions pass both the written and typing tests. The Campbell-Mithun Company of Minnesota finds applicants generally below minimum standards in reading and writing: they have to interview 20 applicants to hire one secretary and 10 applicants to hire one supply or mail clerk. The Motorola Company of Illinois reports that only 20 percent of their applicants can pass a seventh grade English comprehension test or fifth grade mathematics test.

[14] These efforts include well-known partnership arrangements, such as the Boston Compact. However, these are starting to give way to or be supplemented by political action--as in the California Business Roundtable's activities or the corporate takeover of a Chicago school.

independently document mismatches between school and non-school settings in the structure of knowledge used and the social structure of its use. In fact, employers' concerns seem consistent with the results of the shocking NAEP literacy study of young adults 21 to 25 years old in 1986 (Kirsch and Jungeblut, 1986; Venezky, Kaestle, and Sum, 1987), a study that assessed individuals' abilities to handle the verbal, tabular, graphic, and numerical materials and problems encountered routinely in *non-school* settings. Educators' views, on the other hand, seem to reflect trends in student scores on the various achievement and competency tests that are administered routinely within schools but are not systematically benchmarked against non-school performance demands.[15]

THE SIGNALLING SYSTEM BETWEEN SCHOOLS AND LABOR MARKETS

Information theorists and economists talk about "signalling" in markets--things or events that function as indicators or signs of something else. For example, rapidly increasing wages for recent engineering graduates signals a labor shortage of young engineers. Studies of markets indicate that changes in wage levels function to equilibrate labor supply and demand--in other words, labor responds to these signals. A third disjuncture between schools and labor markets lies in the lack of such signalling--or reference--systems between high schools and employers comparable to that which exists between high schools and colleges or between colleges and graduate schools. These systems convey useful information to those selecting among students. They also clarify for students (and their teachers) the selection criteria against which school performances and behaviors are judged by those institutions into which students will funnel.[16]

I wrote about the absence of such systems between high schools and employers in another Aspen Institute paper almost a decade ago (Berryman, 1980), and John Bishop has examined this question in the subsequent years (e.g., Bishop, 1987). As Bishop observes, non-college youth receive economic benefits for staying in high school, *but not for what they do while they are in*

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[15] In the NAEP literacy study, performance increased when the problems were presented in forms familiar from school. For example, 80 percent of white and 40 percent of black 21 to 25 year olds were able to do simple sums when they had the form of school arithmetic tests. Only about 30 percent of the whites and two percent of the blacks succeeded in solving problems that required taking a simple percentage. Very few people could translate a practical problem into quantitative terms.

[16] Schools have a chance to observe--and students to manifest--several behaviors relevant to employers, such as academic performance, attendance, completing work assignments, or the harmony and effectiveness of relationships with supervisors and peers.

school, whether measured by grades, courses taken, attendance, or teacher character references. He also reports a study of the experience of a major Columbus, Ohio, employer, Nationwide Insurance, that tried to set up a signalling system comparable to the transcript/teacher reference system that operates for college-bound youth. Nationwide obtained written permission from each job applicant to obtain their high school records. They sent over 1,200 such signed requests to high schools in 1982 and received only 93 responses. Those responses that were received almost always took more than two weeks. Since a 1982 employer survey shows that 83.5 percent of all jobs are filled in less than a month and 65 percent in less than two weeks, response time lags either jeopardize candidates' chances of getting jobs, or employers have to proceed without relevant information on candidates.

THE STRUCTURE OF INDUSTRIES AND THE RESTRUCTURING OF AMERICAN COMPANIES: ANY LESSONS FOR RESTRUCTURING SCHOOLS?

Usually policymakers, researchers, and the public treat public elementary and secondary education as a *sui generis* institution, effectively isolating our thinking about it from our theoretical and empirical knowledge about the nature and structure of and change in other economic institutions. In fact, public elementary and secondary education is a service industry, whose units (school districts and schools) are structurally analogous to firms and establishments. Can we learn anything about restructuring the public educational system: (1) by comparing its organization to that of other industries; and (2) by examining the experiences of American companies that have had to restructure to stay competitive?

The Structure of Industries

In its report on the American economy, the OTA introduces the concepts of *scale* and *scope* as key to describing how business networks are owned and managed, "scale" referring to the size and "scope" to the product mix of their operations. The OTA argues that different patterns of scale and scope "shape the ability of a business to compete in international markets, dictate the quality and stability of the jobs offered, and determine the success with which new technologies can be exploited." (p.177) The questions that issues of scale and scope raise include: (1) which structures are more aggressive in their pursuit of invention and innovation, and which will be more likely to adopt innovations when they occur? (2) which will be more or less likely to match resources efficiently to demand? (3) which will be more attractive to employees in that they permit greater stability, higher pay, or more unpaid benefits?

All of these questions are relevant to education, but the first may be the most urgent: the ability to innovate, invent, and adopt innovations when they occur. OTA observed that the network of operations leading to educational services remains astonishingly unchanged by the forces that have reshaped other part of the economy engaged in the transfer of information. (p.241) They pointed out the impoverished information, analysis, development, and demonstration base for the massive education enterprise: "While a private information company typically spends several percent of gross revenue on research, virtually nothing is allocated for research directed at the real problems of teaching and learning. If the fraction of gross expenditures invested in research were the same for education as for the average privately owned business in the United States, about $9 billion a year would be spent for education research. This is 60 to 90 times more than the present allocation." (p.49)

Although the OTA notes that there is no good vocabulary for describing the variety of ways that business networks in an economic sector are organized, one of the several organizational patterns that they describe seems particularly relevant to education:

> sectors dominated by small firms operating independently, which are either nominally independent, but constrained by their product or by a lack of research to behave as though they were producing mass-produced commodities (e.g., farms, schools, and home construction); or independent entrepreneurs, providing imaginative responses to new markets and new production technologies. Such firms may pool research or marketing through trade associations (e.g., semiconductor industry in Silicon Valley). (OTA, 1988, pp.177-178)

If public education is properly described as a small firm industry of a particular type, why has agriculture, also a small firm industry, achieved remarkable productivity gains, whereas public education and the home construction industry have not? At the federal level, it is fashionable to blame lack of innovation or adoption of innovation in our schools on the research community. This community is seen as an important source of innovation and felt to have failed to "communicate" or "disseminate" their findings to schools--in other words, schools would adopt these innovations if they only knew of them. Without denying that our research infrastructure could be better organized to serve the educational system, would that the problems lie primarily here. In fact, there seem two much more serious problems.

First, the model of change implicit in this frequent critique of research is very simplistic. If we look at the process by which a new aircraft moves from drawing board to the fleets of civilian

airlines, we find several steps between research into aerodynamics or properties of materials and the purchase and use of the physical embodiment of these ideas: development and testing of prototypes, modifications based on the results of tests, marketing, sales, and followup training of pilots and maintenance crews in flying and maintaining the new aircraft. A new aircraft does not leap, fullblown from the head of Zeus, into a airline's fleet, and it seems implausible to expect research on learning and the educational enterprise to make such a leap into the practices of teachers and schools. New educational practices are technologies just as new aircraft. We cannot do it on the cheap, trying to cut out the intermediate and expensive steps between the knowledge base, the embodiment of this knowledge into technologies, the evaluation or testing and modifications of these technologies, their marketing and sales through strategies such as demonstrations, and training in them. If we return to our question about why the small firm industry of agriculture achieved such remarkable productivity gains, we have to confront the remarkable, federally-sponsored infrastructure that surrounded this industry, from agricultural research through the agricultural extension agent network.

The second serious problem is that you have to have a market--customers--for innovations before you can sell them. Those of us who have criss-crossed the country, speaking to educational audiences about the educational implications of changes in the economy, have been struck by not having anything to plug into. Where is the socket? If these audiences rejected one set of ideas because another set proffered them was more compelling, this would be fine--one aircraft company simply built a better airplane and beat out its competitor. The frightening thing is that *these audiences are not really searching for ways to improve the effectiveness and efficiency of the educational enterprise.* This gets us to the need to provide the motivation to search for improvement, a need that has been recognized in discussions about and policies to introduce old fashioned competitiveness and survival into the public educational system, whether in the form of choice, vouchers, or whatever, and in discussions of school-based management and shared decision making.

The Restructuring of American Companies

American corporations are going through painful restructuring. Can we learn anything from these corporate struggles for restructuring our schools, especially from companies in a business similar to that of schools--knowledge and communication? Or does the analogy between corporate and school restructuring break down almost immediately?

Major cross-national and domestic secular forces affect all American institutions--public and private, not just our corporations. For some obvious reasons, our companies had to walk into the buzz saw of these forces earlier. The questions are what effective institutions look like in this very changed environment; whether effective institutions have common features, regardless of industry and public versus private context; whether the *processes* which successfully restructuring corporations have used to reshape themselves have commonalities; and whether any such commonalities can reasonably be extended to the public sector education "industry".

Certainly there are striking similarities in what restructuring companies and educational reformers are trying to do. For example, corporate hierarchies are flattening out, and responsibility and authority for the production of goods and services are being pushed down to the shop floor level. This process is mirrored in attempts to downsize and restructure the functions of centralized school district administrations, pushing responsibility and authority down to the principal and teacher level. Restructuring companies and educational reformers have also encountered similar barriers. Corporate executives find that employees used to routinized activity and supervision are afraid of new authority and responsibility and have few habits of self-direction. Similarly, at least one school board that tried to decentralize authority and responsibility found many teachers afraid of taking responsibility for the children's learning (O'Keefe, personal communication).

Kearns and Doyle (1988) most recently publicized and popularized the idea that corporate restructuring had some lessons for schools. However, the almost simultaneously released Office of Technology Assessment volume (1988) independently works with some of the same ideas.

OTA points out that the disappointment with the pedestrian ways in which schools use computers mirrors initial corporate experiences with computers. Through painful experience, companies found that they could not parachute computers into the organization if they wanted to exploit their capacities. Work and employee relationships had to be restructured in order to realize the stunning potential of the new information technologies. As OTA (1988) observes, "...firms ranging from insurance underwriters to producers of metal parts have found that the potential efficiency gains from new information technology cannot be captured without a profound change in management strategies. Education will be no different." (p.49)

They point out that schools face a challenge similar to that confronting our service and manufacturing industries: the shift from mass production to flexible production. " ...[M]odern production equipment makes it easier to serve niche rather than mass markets. The American system of education, however, continues to deliver a relatively uniform level of instruction ...."(p.244) "At first blush, the system appears to be highly decentralized and capable of tailoring instruction to individual needs. But closer examination indicates that decentralization has created stunning uniformity. A survey of 1,000 classrooms across the United States found unexpected uniformity in what was being taught, in how it was being taught, and in the texts from which it was being taught." (p.250)

They cite revealing statistics on industry variations in physical capital investments: "We invest less in physical capital in education per employee than in any other industry. In 1985 gross capital stock per employee was $2,000 in 1982 dollars; the industry with the next lowest physical capital investment was legal services at $10,000 per employee--five times as much." (Table 10.9, p.354)

IV. ECONOMIC CHANGES THAT AFFECT POST-SECONDARY EDUCATION AND TRAINING[17]

The implications of economic changes in the U.S. for the postsecondary system are not entirely clear. The economy's turbulence prevents the consolidation of or makes it difficult to discern emerging relationships between workers, employers, and the postsecondary system. The postsecondary system itself is also complex, varying markedly in types of providers, educational programs, financing and governance arrangements, and student characteristics, such as age and educational objectives. The new welfare reform act has even introduced a compulsory quality into what had been a voluntary system. States vary in their "stocks" and uses of postsecondary institutions. Although we have microdata on individuals' use of the system, these are just now being extensively analyzed. Within the next six months, research being conducted under the auspices of the National Assessment of Vocational Education, the National Center for Education and Employment, and the National Center for Research on Vocational Education, now based at the University of California at Berkeley, will both tell us substantially more about relationships between student characteristics, the courses they take, institutional characteristics, and economic payoffs. At the same time, data on the postsecondary educational providers are poor. For some, such as proprietary postsecondary institutions, we know almost nothing.

However, a clear post-secondary issue is the training/retraining of the experienced labor force. This section maps demographic factors that will force the country to focus in an unaccustomed way on the human capital development of adult workers, employers' traditional training investment patterns, and possible changes in those patterns that could generate serious policy problems of differential access to education and training.

COLLISION BETWEEN HUMAN CAPITAL DEMAND AND SUPPLY

Section II documents the tempo of change in the nature and structure of work in American industries and the consequent pressure on the experienced labor force to learn. The nation's demographics increase this pressure. Historically, employers have been able to fill their demands for greater human capital by replacing each retiring cohort of workers with a better educated and usually larger cohort.

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[17] "Post-secondary education and training" refers to all formal human capital investment that occurs after high school. Thus, it includes, not just two year or four year college, graduate school, and professional school programs, but also post-secondary proprietary vocational programs, employer-sponsored in-house training, military training, and public sector training programs.

We can no longer do this. By 1990 the U.S. population will be growing more slowly than at any time in the nation's history, except for the decade of the Great Depression. The nation's workforce is also growing more slowly, and its growth rate will continue to fall. Between 1970 and 1980 the workforce--the number of people working or looking for work--grew at about 2.5 percent annually; between 1980 and 1990, it will have grown by about 1.5 percent annually; and between 1990 and 2000, it is projected to grow at about one percent annually. As a result the workforce is aging. Between 1985 and 2000, the population will grow by 15 percent, but the number of people between the ages of 35 and 47 by 38 percent and those between 48 and 53 by 67 percent. The number of those between 16 and 19 years of age is declining absolutely, and the share of the workforce between 20 and 34 is falling (Hudson Institute, 1987).

Compounding the numbers problem is that the smaller replacement cohorts will consist increasingly of individuals from less educated groups--the poor and recent immigrants. In 1970 nearly half of the new entrants were white men; between now and the year 2000, white men are projected to constitute only 15 percent of the new entrants; white women, 42 percent. Non-whites--who constitute 10 percent of today's labor force, will make up 20 percent of the new entrants; immigrants, who constitute about 7 percent of today's workforce, about 22 percent (Hudson Institute, 1987).

These realities mean that employers' human capital needs will have to be met more by retraining existing workers. Who will employers pick to retrain? Who will get left out? In other words, old questions become more urgent: the level, nature, access, and consequences of employer-financed training for the experienced labor force. The next two sections look at this question. The first summarizes what we know about employers' patterns of training investments. The second looks at recent changes in companies' human resource strategies and their implications for changes in employers' training patterns.

EMPLOYERS' TRAINING INVESTMENT PATTERNS AND THEIR CONSEQUENCES

Analyses of longitudinal and cross-sectional data bases reveal certain employer training investment patterns and consequences. These data bases cover the years 1966 to 1983.

• **Education** begets training. In every data base, years of formal schooling emerges as one of the most important determinants of postschool training investments--employers train the most trainable (Mincer, 1988; Lillard and Tan, 1986; Tan, 1988). Those with limited formal schooling thus face limited training opportunities. Since training is strongly and independently related to on-the-job wage growth (Tan, 1989; Mincer, 1989)[18] and employment stability (Mincer, 1989),[19] those with less formal education also face lower wage growth and higher probabilities of unemployment.

• **Training** begets training. Workers who are more apt to receive training in one job are more apt to receive training in subsequent jobs (Mincer, 1989).

Losers in the training game: those with a poor initial education. A poor education has cascading economic consequences for the individual and for the society. The less educated have more difficulty getting a job, and, even when they are employed, employers are also less apt to invest training in them, thus depriving them of the wage growth and employment stability associated with employer training investments.

• The younger the age of the equipment, the greater the share of more educated workers. This effect of new equipment is magnified in R&D intensive industries (Bartel and Lichtenberg, 1987; Gill, 1988). However, as technology ages, the share of more educated workers declines (Mincer, 1989).

• In the short run, technological innovation in a sector increases the share of that sector's educated workers without significant initial effects on on-the-job training. In the longer run, training increases, whether the technology ages or grows at a steady rate (Mincer, 1989). These results seem consistent with those of Lillard and Tan (1986): in the short run, productivity growth increases outside (classroom) training, leaving on-the-job training unaffected or decreasing it; in the

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[18] Tan (1988) shows that the effects of training on earnings and earnings growth vary by source and type. Company training has the greatest positive effect on earnings, and this effect persists for over 13 years. The effects of training from other sources are much smaller and persist for between 8 and 10 years. When types of training are considered, managerial training increases earnings the most, but its effects are less enduring (12 years) than the effects of semi-skilled manual training (15 years).

[19] Training increases firm tenure, even for employees with a history of mobility prior to entering the firm in which the training occurs (Mincer, 1988).

long run, productivity growth increases in-house training and decreases outside or classroom training.

• Relative to low-technology industries, high-technology industries increase the probability that those with more education will get more company training. They decrease the probability that those with less education will get company training (Tan, 1989).

Losers in high productivity growth industries: again, those with a poor initial education. These data also underscore the interactions between new technologies, productivity growth, and a well-educated labor force. All else equal, a less educated labor force constrains the process by which companies absorb new technologies--and, therefore, the speed with which they yield productivity payoffs.

• The cumulative probability of receiving training after labor force entry increases rapidly after the first year of work and continues to increase, although at a declining rate (Tan, 1988; Mincer, 1988). However, the pattern varies by occupation: in some, such as the professional and technical occupations, training is concentrated in the first few years in the labor market; in others, such as management, it is acquired more slowly. Company training increasingly displaces training acquired in business or technical schools as the worker's years in the labor market increase.

• Employer training investments vary by occupation and industry. Among white collar occupations, they invest the most heavily in professional and technical workers, followed by those in administrative and managerial jobs. Those in the service occupations receive the least training. Among the blue-collar occupations, employers invest the most heavily in craft and precision workers, followed by machine operators. They invest the least in laborers. Among industries, the least investment occurs in agriculture, forestry, and fishing; non-durable manufacturing; and retail. Industries with higher levels of training investment include durable manufacturing; transportation, communications, and utilities; finance, insurance, and real estate; professional services; and public administration.

• With few exceptions, relative to white males, non-white males are significantly less likely to get most kinds of post-school training, even when analyses control for a comprehensive set of observable worker characteristics. This result is especially striking for company training, regular schools, and undefined "other" training sources. The differences are less pronounced among

younger men than among older men, and race has much less effect on female than on male training experiences (Tan, 1988).

- In general and for these data bases, union membership has a negative effect on the probability of most sources of training, including company training (Tan, 1988; Mincer, 1988).

Losers in the training game: older workers; black male workers; workers in lower skill occupations; union members.

ARE EMPLOYER TRAINING INVESTMENT PATTERNS CHANGING?

As noted above, these employer training investment patterns are based on data collected between 1966 and 1983. Are these patterns changing? We know that some unions are changing their relationships with management, in some cases trading wage gains for training opportunities. Tan's analysis shows greater race effects on training for older than for younger males. Is this difference just an age effect--in other words, as these younger cohorts age, will the training gap widen? Or does it reflect a structural shift toward greater training equity between the races?

However, there may be another and broader change occurring. Employers' commitments to employees may be changing, opening up new training "holes" by altering the mechanisms of intra-firm and inter-firm mobility and employer incentives to invest in training. These changes have particular implications for less skilled workers and for our traditional and non-traditional post-secondary education and training system.

Until recently, the twentieth century trend in the United States had been towards stronger attachments of workers to their firms and more highly developed *internal labor markets* (Gordon,

Edwards, and Reich, 1982; Noyelle, 1987; Abraham, 1988; Carter, forthcoming; Jacoby, 1985).[20] These markets arose primarily in the core sector of the economy and primarily because firms in this sector operated in an oligopolistic or monopolistic environment--for example, the steel, automobile, local gas and electric utilities, and telephone industries (Noyelle, 1987). An important feature of these markets has been that they offer job security and advancement even to those with limited skills.

There is growing evidence that internal labor markets may be weakening, implying less committed employer-employee relationships (Noyelle, 1987; Abraham, 1988; Office of Technology Assessment, 1988) and a potential shift of the training burden from the employer to the employee, especially to those with the least initial education and most limited financial resources to purchase more. Although employer-sponsored training occurs both in-house and through independent post-secondary educational and training institutions, any shift from employer-sponsored to employee-sponsored training would seem potentially to shift, not just the financial burden from employer to employee, but also the location of training from the corporation to the post-secondary education and training system.

The tie between employer and worker seems to be loosening in three ways. The first is extensive and increasing substitution of market-mediated work arrangements for direct employment relationships, "market-mediated transactions" including the use of agency temporaries, short-term hires, on-call workers, and contracting out ("out-sourcing") of production and support services--for example, high skill business services and low skill services such as maintenance and security.

Abraham (1988) estimates that in 1986 about 10 percent of total employment was market-mediated. Her data also suggest more rapid growth in all categories of market-mediated work than in other types of employment. With the exception of high skill business services, such as

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[20] Abraham (1988) describes characteristics of these markets: "Within an internal labor market, the compensation and allocation of labor are governed by administrative rules and procedures, rather than determined in direct response to market forces. Insulation from immediate market pressures has some significant potential advantages....[A]dministrative decisionmaking economizes on market transaction costs. Many internal labor markets are characterized by the presence of career ladders that encourage long-term employment relationships. Such relationships permit the development of firm- or industry-specific skills that workers who change employers frequently do not acquire, thereby enhancing workforce productivity. In addition, they may make it possible to structure compensation over the work life in ways that strengthen employees' incentives for good performance." (p.1)

accounting firms, workers in market-mediated arrangements are less skilled. They also usually work in small firms, such as temporary help agencies, that typically do not invest in worker training.

The second way in which employer-employee ties seem to be weakening is the increased use of high turnover parttime help. Parttime workers are also usually less skilled and less apt to receive training. *Ceteris paribus*, employers invest in training when they expect to capture its benefits for the firm, and they usually see a parttime employment relationship as too tenuous to warrant training investments.

The third way is increased recruiting of educationally credentialed and technically trained personnel in the external labor market, a strategy that expands the number of lateral ports of entry into firms, reduces employers' training investments in less skilled employees, and severely disrupts the old system of internal promotion. Noyelle (1987) uses the terms *professionalization* and *para-professionalization* of jobs to describe this pattern of mobility that seems to have become more occupation- than firm-driven. In other words, access to jobs that are not traditionally considered "professional" jobs seems to depend increasingly on the kinds of investments typical of the professions: (1) individual investments in education and training to obtain control over a body of knowledge and practice; and (2) the sale of this expertise in a self-employment context, market-mediated work arrangement, or through lateral entry into the firm. To the extent that Noyelle's observations for the industries that he has studied generalize broadly, the postsecondary system should be assuming a new importance even for medium skill jobs, in that an increasing number of jobs require completing post-secondary programs of study.

The apparent increase in lateral entry workers, selected for their education, has implications for the economic opportunities and lifetime earnings of less educated workers and for the postsecondary system. It increases the need for externally obtained credentials and "strands" the less educated component of the company's work force. (Recall bank tellers and mill operators.) Since external hires fill the higher level slots, the less educated workers do not receive either the training or the work experience associated with moving up through the firm. If internal markets are disrupted by increased numbers of lateral entry ports, promotion and therefore wage growth depends on obtaining more education and training, *often outside of and not paid for by the company.*

In trying to understand the future implications of these current shifts, it has to be remembered that the American economic restructuring process involves experiment and short- as well as long-run adjustments. The three trends just outlined may not continue; they may stabilize or reverse.[21] However, education and training policymakers need to monitor them. The industry case studies described in Section II all show the *routine* and continuous need for education and training. The trends just listed exacerbate employers' traditionally lower training investments in the less educated, in that all three trends tend, not only to shift the education and training burden to the individual, but often to those with the least initial education and most limited financial resources to purchase more. In other words, depending on what happens as restructuring continues, we may be confronted simultaneously with a greater need for post-secondary education and training and a growing policy problem of differential access to education and training.

It has been argued that, given the demographics, employers will have to compensate for experienced workers' or new entrants' poor initial education. In other words, employers will close the gap between skill demand and supply; it will not end up as a public policy problem. This strikes me as illusory. Traditionally employers do not invest training in the poorly educated; they are shifting increasingly toward the credentialed; and, impressions to the contrary, the most recent estimate of what the corporate sector actually spends on training *basic* skills in their employees--in other words, compensating for their employees' initially poor education--is only eight-tenths of one percent of the corporate training investment (A. Carnevale, personal communication).[22]

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[21] For example, Noyelle's (1987) case study of the retail garment industry reveals both increasing use of parttime sales personnel and the emergence of a two-tiered hiring process separated by a college education. However, he also found that companies such as R. H. Macy & Co. are recognizing that the limited attachment of the sales force to the firm reduces work quality. They see that the next jump in productivity requires increasing quality. How companies will achieve this jump is not clear, but it may require changing policies such as relying on high turnover parttime sales help. This example illustrates the role of employers in creating a quality workforce. Quality problems attributed to the schools are sometimes a joint function of school and employer failures. In some cases the fault lies almost entirely with employers--they get what they select, pay for, and signal. Nordstrom's, a West Coast retail firm that has just expanded into Eastern markets, recognized a market niche for high quality service. It has differentiated itself from other retail firms by delivering service, achieved through recruiting, training, compensation, promotion, and firing policies that reinforce one another to communicate, encourage, and enforce corporate service standards within the company.

[22] If the total investment is estimated at $30 billion, the bill for basic skills is $240 million, which is relatively small.

V. EDUCATION AND THE ECONOMY: WHAT IS THE FEDERAL ROLE?

This paper has certain implications for the federal role in education.

• **Reconceptualize the federal role in education.** We all "know" that adults engage in substantial educational and training activity--and, in fact, in 1986 those 25 years and older constituted 38.6 percent of all enrollments in institutions of higher education (*Condition of Education*, 1988, Table 2:17-1). We also know that large sectors of our post-secondary system, especially the community college system, thrive by serving these individuals. However, our thinking about the federal role in education continues to be driven by traditional images of "education" as a young person's, not an experienced worker's, activity and as preparation for, not as integrated with, adulthood. For example, older students only show up in enrollments by age (25 years and older) in the Department of Education's statistical profile of education, the *Condition of Education*. We have various words for adult educational activity--"continuing" education, "adult" education, "recurrent" education. Within the traditional educational policy community these terms all have a marginal ring--they do not denote "real" education, although for those educational institutions supplying this market, these activities are anything but marginal.

Our demographics and economic changes both imply a reconceptualization of the federal role in education as earlier (early childhood education, especially for children from poor families) and later (retraining), rather than as an activity that a child starts in the first grade (kindergarten in some states) and that a young person completes, with or without a secondary or post-secondary degree.

• **Lead efforts to revitalize elementary and secondary education.** This paper underscores the critical importance of a high quality elementary and secondary education for all students, whether we are talking about access to employment, employment stability, or access to employer-sponsored training, with its independent effects on wage growth. However, something is deeply and systemically wrong with public elementary and secondary education, exceptional schools or districts not withstanding. The federal government can force questions and debate about the system's organization, governance, financing, performance objectives, accountability indicators, human resource policies, and "protected market" status. If it is to remain a small firm industry, the federal government, in conjunction with the states, can consider whether and how to create a

research, development, testing/modification, and demonstration infrastructure that can make empirically grounded improvements available in a form that schools can "see" and use.

• **Invest in educational R&D.** Research and development is a natural, economies of scale activity for the federal government. This paper argues for several candidate investments: (1) develop, experimentally implement, and evaluate new information technologies for schools; (2) accelerate research on how people learn in non-school settings and on how to map the research implications back into school curricula and pedagogy; (3) develop, advertise, and lobby for accountability measures more congruent with the skills that we want students to acquire--for example, higher order cognitive skills, learning how to learn; and (4) invest in stronger and more complete statistics on students and the educational system.

• **Eliminate narrowly job-specific vocational education at the secondary level, integrate academic and vocational learning at the secondary level, and extend this integration down through the elementary grades.** In some respects, skill requirements for jobs are becoming more generic and less job-specific. The need for all students to acquire generic work-related skills argues against secondary occupationally-specific programs unless these are well integrated with symbolically-based learning. Consider moving from tracked curricula in comprehensive high schools to magnet, theme, or strong technical high schools that contextualize symbolically-based learning for all students. Push contextualized learning down into the elementary grades to give meaning to and involve at-risk and not-at-risk learners in symbolic learning.

• **Work on the Balkanization of Education and Training Policy.** Issues of human capital and productivity cut across schools and the workplace, students and workers. For example, workers rely heavily on the postsecondary system. However, traditionally, the Department of Education restricts its vision to the schools; the Department of Labor, to the labor force. This balkanization shows up in vocabulary, policy, and program, helping to maintain the disconnects discussed earlier. For example, as long as many of the federal mop up programs are lodged in the Department of Labor, but the need for them and potential alternatives to them lie in the Department of Education's jurisdiction, the issue never gets joined.

• **Think through a Policy on Training Vouchers for Workers.** The need for continuous education and training and corporate training investment patterns open up the subtle but pernicious possibility of losers and winners. We already know that the better educated are much more apt to

receive formal corporate training (e.g., Lillard and Tan, 1986). Corporate training interests are not necessarily those of individual workers or the public. When we look at the full array of federal legislation that finances training, including the tax laws, what "coverage" holes do we find? Do they matter? What would a hypothetical voucher system look like--for example, who pays, who receives?

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